

Enterprise Architectures and Integration Using SOA

Concepts, Methodology and a Toolset

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BOOK OUTLINE

PREFACE

SUGGESTED USAGE IN A COURSE

ACRONYMS

MODULE (OVERVIEW): The Big Picture

Chapter 1: Enterprise Architectures and Integration – The Big Picture

MODULE (ENTERPRISE): Business Architectures and Application Architectures

Chapter 2: Business Architectures: Business Strategies, Processes and Structures

Chapter 3: Enterprise Applications and Enterprise Application Architecture

Chapter 4: ERP Systems: Portals, CRMs, Procurement and Supply Chain Management Systems

MODULE (TECHNOLOGIES): Technology Architectures

Chapter 5: Overview of Enabling Technologies and Technology Architectures

Chapter 6: Web, XML and Semantic Web

Chapter 7: Web 2.0, Social Networks and Web Services

Chapter 8: e-Commerce Platforms and Distributed Transaction Management

MODULE (INTEGRATION): Integrated Architectures Through SOA

Chapter 9: Service Oriented Architectures and Web Services

Chapter 10: Enterprise Application Integration through SOA

Chapter 11: B2B Trade and B2B Integration Using SOA

Chapter 12: Reengineering for SOA: Reuse, Migration & Warehousing Strategies based on Cost, Performance & Security

Chapter 13: Integration with Mobile Users – The Wireless Integration

MODULE (TUTORIALS): Tutorials on Basic Technologies (available on author website)

Chapter 1: Network Technologies -- A Tutorial

Chapter 2: Object-Oriented, Java, and UML -- A Tutorial

Chapter 3: Database Technologies and SQL -- A Tutorial

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PREFACE

This book is based on corporate experience, consulting assignments, teaching courses (Penn, Fordham grad school), and also research on computer aided consulting. This topic and format of the book has been greatly influenced by practical insights gained through numerous consulting assignments and discussions with practitioners from different industry segments and World class organizations such as IBM, the United Nations, and Telcordia Technologies. Development of graduate level courses in this overall space at the University of Pennsylvania, Fordham Graduate School of Business and Harrisburg University of Science and Technology have also influenced this book. The salient features of this classroom tested book are:

- Emphasis on recent and relevant issues
- Mixture of business and technologies, not just business or pure technology
- A systematic approach that defines an enterprise architecture into broad building blocks and then covers each building block in depth (see Exhibit 1)
- Several case studies and examples to illustrate the key points.
- A step by step methodology that shows how all the pieces fit together
- A computer aided decision support system (PISA) that can be used in classroom exercises

Exhibit 1: Book at a Glance

Enterprise systems are essentially large scale, in many cases global, distributed systems that consist of several broad building blocks. Basically:

Enterprise Architecture = Business Architecture + Application Architecture + Technology Architecture + Integration Architecture

This book basically covers these building blocks and is organized in terms of the following modules:

- **Overview Module** (chapter 1) paints the big picture of enterprise architectures and integration by using SOA as a conceptual framework. An overall methodology and a computer aided toolset is presented and illustrated through an example.
- **Enterprise Module** (chapters 2 to 4) concentrates on business and application architectures and covers topics such as business strategies, business process modeling, enterprise applications, ERP (enterprise resource planning) systems, and enterprise application integration.
- **Technologies Module** (chapters 5 to 8) primarily concentrates on the technical architectures that enable and support the business and application architectures. Main focus of this module is on the Web technologies with topics such as middleware services, the classical Web, XML, Semantic Web, Web 2.0, Web Services, e-Commerce platforms and transaction management.
- **Integration Module** (chapters 9 to 13) examines how to architect new and integrate existing applications by using SOA. This module covers a wide array of topics such as SOA, enterprise application integration through SOA, B2B trade and B2B integration using SOA, reengineering methodology for SOA and integration of mobile computing and mobile users using SOA.
- **Tutorials Module**, available from the author website (www.amjadumar.com), includes tutorials on basic technologies so that the book can be of value to novices as well as experienced practitioners.

The Learning Package (Text, Courseware, and Toolset)

It is very difficult to teach courses that cover concepts, methodologies, design tradeoffs, and evaluation of different solutions by relying on just powerpoint slides and discussion of case studies. Engaging the students in problem solving exercises is a valuable learning experience. Based on several years of consulting, management, and university teaching experience, I have assembled a package, shown in Figure 1, that consists of this text, lecture materials and a computer aided toolset. This package has been used in academic courses (management/engineering schools) and corporate training with very good results.

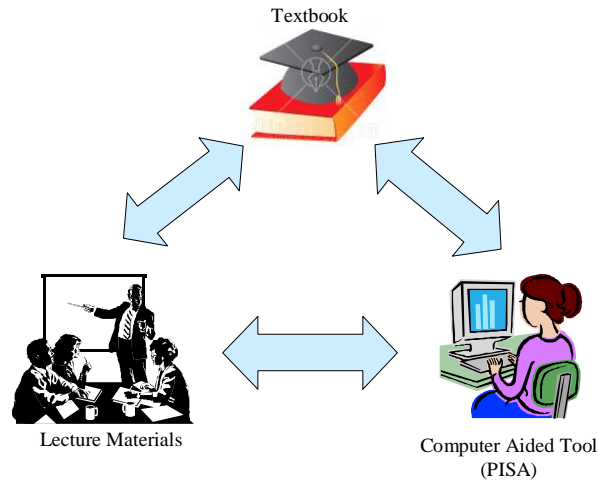


Figure 1: The Learning Package

Textbook: This practice-based book examines the most recent and relevant issues in enterprise architectures and integration. Concepts include business strategies, business process modeling, enterprise applications and ERP systems, enabling IT infrastructure (especially Web technologies), service oriented architecture (SOA) and enterprise integration. A methodology is introduced to architect solutions and integrate enterprise applications by using Web Services and SOA. Several case studies and examples to illustrate the key points.

Lecture Materials (Courseware): Classroom tested lecture slides can be freely downloaded from the author site. Instructors can access student projects, sample exams, and other teaching materials. Through an instructor only site. See the author site (www.amjadumar.com) for details.

PISA (Planning, Integration, Security & Administration) Toolset: A practice-based computer aided consulting environment is available to support the text and the lecture materials. PISA can be and has been used extensively for academic as well as corporate training courses on IT planning, SOA, enterprise architectures and integration, information security, IS analysis and design, project planning and IT governance. The students seem to really enjoy PISA experiments and typically “dry” topics come to life. Free access for a limited period is available. See the PISA website (www.ngepisa.com) and visit the ‘Learn More’ Section of the Website for additional information.

Conventions Used

We will use the following conventions in this book. **Highlighted italics** are used to indicate definitions of new terms, *italics* are used for emphasis and **bold letters** are used for subject headings.

Intended Audience and Recommended Usage

- IS Managers who want to understand the key concepts of enterprise architectures, integration and SOA
- IS technical staff who want to understand the role of technologies in enterprise architectures
- IS students who want to get through their programs with minimal damage to their body and soul
- Computer science students who want to link reality to their algorithm oriented courses in enterprise systems
- All others who just want to read books written by good people

Acknowledgements

This book, the course that I have taught and the PISA toolset has been greatly influenced by my interactions with my numerous friends at IBM. In particular, Alan Glickenhause,,,. The learning package (book, course materials, pisa toolset) have been partially funded from an IBM Grant and the the book outline has been greatly influenced by the IBM Seminar ‘On Demand Skills for the Globally Integrated Enterprise’, Friday, October 26, 2007.

I am greatly indebted to my wife, Dolorese, who keeps supporting me through this endless writing process. Several students and practitioners who read through draft versions of this book also contributed a great deal to its content.

Suggested Usage in a Course

I have developed and taught courses on different aspects of IS architectures and integration for than a dozen years at different universities (University of Pennsylvania, Fordham University and Harrisburg University) and professional settings (Society of Manufacturing Engineers, Frost and Sullivan, and telecommunications sector seminars). Although the courses have evolved over the years and the content varies with audience, a recent and generic course description and outline follows.

Course Title: Enterprise Architectures and Integration

Other Possible Titles for the same course

- E-Business Technologies and Integration
- Web Technologies, Architectures and Integration
- Managing Systems Integration Projects
- Computer Integrated Manufacturing

Course Description

Modern global enterprises are characterized by increased automation, mobile services, extended B2B operations with global business partners, and on-demand business services. The main issue in such enterprises is to architect and integrate a very wide range of services quickly and effectively to cope with rapidly changing business conditions. This course presents a 'systems' perspective that combines processes, people and technologies and highlights the role of infrastructure challenges, Service Oriented Architecture (SOA) and security plus QoS issues in enterprise computing. Instead of one narrow topic, this course establishes a broad conceptual framework that integrates the key building blocks of enterprise wide systems and addresses new challenges as new technologies, techniques, methodologies and standards emerge. The course is roughly divided into four parts. The first part establishes the overall conceptual framework and identifies the key building blocks (enterprise models, business processes, enterprise applications, and analysis tools). The second part introduces and reviews the enterprise computing environments and the IT infrastructure in the global economy. The third and fourth parts concentrate on developing and evaluating integrated architectures using the latest thinking in service oriented architectures (SOA), architecture frameworks, integration patterns, and evaluation techniques. A wide range of case studies (successes and failures) will be discussed and hands on integration projects will be assigned for experimentation with available tools.

Course Prerequisites

- Basic understanding of IT concepts, equivalent to the text: "*Management Information Systems*", Kenneth C. Laudon and Jane P. Laudon, Prentice-Hall, 10th Edition (2007) or later edition
- Additional courses in IS analysis and design or industry experience in IT involving system analysis, system design and architecture, equivalent to the text "*Systems Analysis and Design*", by Satzinger, Jackson, and Burd, Course Technology, latest edition (4th edition or higher)

Main Text:

Umar, A "Enterprise Architectures and Integration Using SOA", NGE Solutions, Inc. Jan 2010.

Additional Texts

- Carter, S., “The New Language of Business: SOA & Web 2.0”, IBM Press, Feb 2007
- Bieberstein, N., et al, “Service-Oriented Architecture (SOA) Compass: Business Value, Planning, and Enterprise Roadmap”, IBM Press, Oct 2005.

Course Grade

- Three projects (300 Points)
- One Examination - in class, open book, open notes (100 Points)
- Attendance, participation and homeworks (100 Points)
- Total: 500 points
- Straight Percentile Grades

Course Outline

Week	Major Topic	Readings
1	Introduction to Enterprise Architecture and Integration	Chapter 1
2	Business Architectures: Business Processes and Business Process Integration	Chapter 2
3	Application Architectures: Enterprise Applications (CRMs, ERPs, eMarkets, SCM, Portals) and Enterprise Application Integration	Chapter 3
4	Enterprise Resource Planning Ssystems	Chapter 4
5	Technology Atchitectures; An Overview	Chapter 5
6	Role of Web and XML in Integration	Chapter 6
7	Semantic Web, Web 2.0 for Integration	Chapter 7 plus handouts
8	Examination	
9	Service-Oriented Architectures (SOA)	Chapter 9 plus handouts
10	Enterprise Application Integration through SOA	Chapter 10 plus handouts
11	B2B Trade and Legacy System Integration	Chapter 11
12	Cost Estimation, security & Performance Issues	Chapter 12
13	Mobile Computing and Wireless Integration	Chapter 13
14	Trends and Wraup	Handouts
15	Student Presentations	

Suggested Projects and Assignments

The following assignments and projects are suggested (see hints and helpful suggestions):

- **Homework (30 points).** An early homework assignment to test and smooth the backgrounds of the students. Specifically, the students will be asked to choose an enterprise from a list of possible industry segments (e.g., manufacturing, telecom, healthcare and retail) and develop a model of the enterprise that can be used in business process re-engineering and integration.
- **Team Project 1 (100 points):** Choose a small to medium business (SMB) and develop a business and enterprise application architecture for the company . (2-3 per Team)

- Part A: Develop the architecture by hand
 Part B: Develop the same architecture by using PISA. Compare and contrast the results
- **Team Project 2 (100 points):** Develop a technology architecture for the chosen company that supports the business and applicature architectures developed in Project 1 (2-3 per Team)
 - Part A: Develop the architecture by hand
 - Part B: Develop the same architecture by using PISA. Compare and contrast the results
 - **Team Project 3 (100 points):** Develop an Integrated Enterprise Architecture for the same company based on SOA - (2-3 per Team)
 - Part A: Develop the architecture by hand
 - Part B: Develop the same architecture by using PISA. Compare and contrast the results
 - **Other Possible Projects (100 points):** Free For All: Choose a topic of your choice within the scope of this course and present your findings in class. Your presentation may take one of the following formats:
 - Selection and demo of a tool that could be of value in architecture and integration problems. This could be, for example, use of a simulation tool to evaluate architectures
 - Research presentation that includes a survey and critical analysis of a topic within the scope of this course. This may show, for example, the use of OR techniques in building and evaluating architectures.
 - Examine the decision support tool (PISA) by developing the architecture and integration solution of a real life project chosen by you. Do a critical analysis of the results produced

Notes:

- The projects can be based roughly on the XYZCorp case study that is sused throughout the textbook. Sample projects and homework assignments can be found on the author website (www.amjadumar.com)
- The use of PISA is not required but highly recommended for projects in this course. PISA can be used in the third project or can be “threaded” in all projects as suggested above.
- The students will get one week free access to PISA so the PISA projects will not require additional costs.

Discussion of case studies, examples, commercial products, and trends:

The course uses several case studies, examples, and commercial products at different points in the course. The case studies at the end of each chapter can be used for discussion and analysis.

Overview and Use of the PISA Toolset

It should be clarified that PISA is *not* required for this text. The suggestion of using PISA for this text is primarily based on the experience of using PISA for teaching this course, especially since 2007. The PISA toolset is available to the students free for one week and at minimal cost afterwards.

PISA (Planning, Integration, Security and Administration) environment, shown in Figure 2, provides a family of automated consultants (*advisors*) that are segmented into three modules:

- **PlanIT** (Planner for IT) concentrates on IT planning projects and develops a plan at the enterprise level. PlanIT provides support for the enterprise and IT infrastructure activities.
- **AIM** (Architecture and Integration Module) deals with the more detailed issues of how specific components of the plan can be architected and integrated to form a functioning system based on the SOA principles.
- **SAM** (Security and Administration Module) provides security and administrative services to the entire PISA system

Each PISA advisor, as shown in the outer circle of Figure 2, supports a specific stage and collaborates with other advisors to produce plans. For example, the Network Advisor supports network planning stage and collaborates with the Security Advisor to develop a security plan that includes a secure network. The PISA advisors build different parts of the architecture and then allow the company to compose a comprehensive integrated enterprise architecture. In addition to the three main modules of PISA, it has two additional modules: a) **Enterprise Composer (EC)** that allows a user to build larger enterprises from smaller ones, and b) **Advanced Capability Module (ACM)** that provides simulation and detailed modeling capabilities.

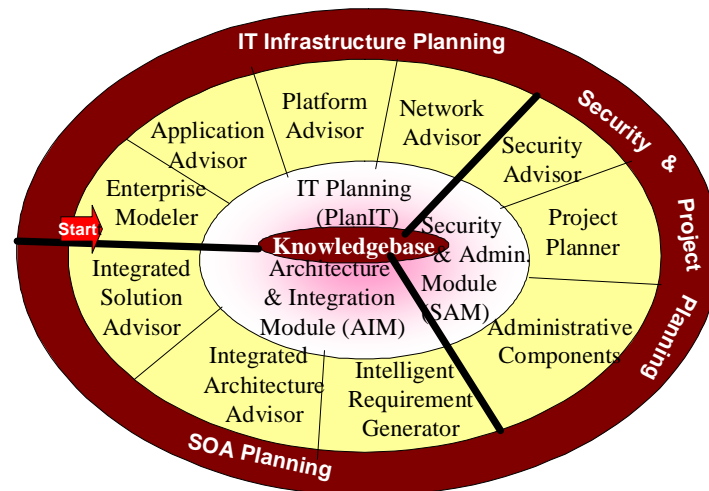


Figure 2: Conceptual View of PISA Environment

To understand the sequence in which these advisors are invoked, start from the Enterprise Modeler ("Start" arrow in Figure) and follow the circle clockwise. Specifically, the PlanIT advisors do the following: the Enterprise Modeler develops a model of an enterprise, the Application Advisor develops an Application plan, the Platform Advisor develops a computing platform plan, and the Network Advisor builds a network plan. The SAM advisors develop a security plan, a project plan, and provide

other administrative services. The AIM advisors develop an integrated architecture plan based on SOA. The advisors are not strictly sequential – different advisors can be invoked in different sequences based on the type of business scenario. However, some things have to be done in sequence. For example, you cannot secure a network before developing a network plan (naturally!). The PISA Control Panel guides the user through what can be invoked when. Exhibit 2 shows some sample PISA projects. Additional information about PISA can be found at the PISA Website (www.ngepisa.com).

Exhibit 2: Sample PISA Projects

Note: Each one of these projects takes less than half an hour to complete

PROJECT 1: Developing an IT Plan and a rough enterprise architecture for a small to medium company (SMB). Use PISA-PlanIT to conduct the following experiments:

- Develop model of the SMB by using Enterprise Modeler.
- Develop an application plan by using the Application Advisor.
- Develop the technology plan by using the Platform Advisor and the Network Advisor.
- Now repeat these steps for a few different companies and industries

PROJECT 2: Develop a Security and Management Plan. Use PISA-SAM to conduct the following experiments;

- Given the IT Plan generated in Project 1, develop a security plan
- Conduct risk analysis by running attack trees
- Generate a security audit list, and develop a business continuity plan
- Produce an IT project plan and port the produced project plan into MS Project
- Develop an IT governance plan
- Now repeat these steps for a few different companies and industries

PROJECT 3: Develop an Integrated Enterprise Architecture by Using SOA. Use PISA-AIM to conduct the following experiments:

- Given the IT Plan generated in Project 1 select the integration projects
- For each integration plan, generate integration requirement documentation
- Generate architecture document that captures a logical SOA-based architecture
- Generate a solution evaluation based on cost, performance, and security estimates

PROJECT 4: Compose B2B Scenarios from Multiple Individual Scenarios. Use PISA-EC to conduct the following experiments;

- Given individual companies, build a supply chain network
- Build an acquisition scenario where one company acquires another one
- Build model of a large organization from small organizations
- Develop a B2B business network from individual companies . .

PROJECT 5: Develop simulation or detailed models based on the models produced by PISA. Use PISA-ACM to conduct the following experiments;

- Given an enterprise model (in XML), produce a BPEL simulations
- Given a network model (in XML), produce network simulations by using Opnet Simulator
- Given AIM output (in XML), connect it to a commercial ESB . .
- Build a game based on any of the models produced by PISA

